

PUBLIC HEALTH ENGINEERING

TRAINING FOR THE PUBLIC HEALTH ENGINEER*

DISCUSSION

EARLE B. PHELPS

*Professor of Sanitary Science, College of Physicians and Surgeons,
Columbia University, New York, N. Y.*

PROFESSOR Prescott has very clearly set apart the profession of public health engineering from that older branch of the engineering school with which it is even today so commonly confused, namely, sanitary engineering. This difference, as he has indicated and which the writer would re-state because of its importance, is largely one of emphasis. The sanitary engineer is primarily a designer or a builder. He is, in fact, a civil and hydraulic engineer specializing in a rather restricted field, confined for the most part to works relating to municipal water supply and sewerage.

The public health engineer on the other hand is primarily a student and worker in the field of public health. The range of his activities is wider, and his training and knowledge are of essentially different character. It is not so important that he know how to build a sewer as that he know why sewers are necessary and what results may be anticipated from the discharge of their contents without treatment into a body of water. Trained to think with the clearness and accuracy of an engineer, he employs as his material the data of physics, chemistry, and biology which

underlie the present-day practice of public health.

Working with the physician or the physiologist he may make important contributions in such fields as school hygiene, or industrial hygiene, when the problems are largely physiological or pathological. The writer assumes that Professor Prescott's inclusion of industrial hygiene and health hazards in industry, within the scope of public health engineering, refers to the environmental aspects of these problems and not at all to their purely medical aspects.

Professor Prescott has indicated in some detail the content of a 4-year undergraduate course at the Massachusetts Institute of Technology leading to the degree of Bachelor of Science in Public Health Engineering. It may be of interest, therefore, to refer in comparison to the postgraduate course offered at the DeLamar Institute of Public Health, College of Physicians and Surgeons, Columbia University, in which we attempt to accomplish essentially the same object in a distinctly different manner.

This course is based upon the reasoning employed above in defining the public health engineer. It is a course of 1 full year, of 12 months, open to acceptable graduates in civil engineering and leading to a degree of Master of Science in Public Health Engineering. It presupposes adequate engineering training

* Discussion of paper by S. C. Prescott, read before the Public Health Engineering Section of the A. P. H. A., at the Sixtieth Annual Meeting at Montreal, Canada, September 17, 1931 (see October JOURNAL, page 1091).

and attempts to provide the supplementary public health background necessary to direct the young engineer's activities into channels which are essentially new to him and which lead him to consider the relationships between the environment and human health. Among the prerequisites therefore are adequate courses in physics, chemistry and either general biology or bacteriology. Since these last two subjects are generally weak and sometimes lacking in engineering education, the candidate may be required to complete certain work in the summer school previous to entering upon his year's study, and in any event the laboratory work has to be begun in a more elementary manner than is usual in graduate studies.

We have the distinct advantage, however, of having the candidate strictly within a small department for most of his time, which permits of intensive courses and close correlation between courses. We believe it also to be an advantage, rather than otherwise, that the student has completed his formal engineering studies so that the entire time and attention of a somewhat more mature student can be devoted to systematic training in public health.

The major work of this course is given under the titles "Public Health Engineering" and "Public Health Engineering Practice." In the first of these the subject is dealt with along the lines of the writer's textbook, *Principles of Public Health Engineering*, namely, the three major environmental contacts—air, water, and food—and certain other miscellaneous environmental factors. Under air we study both ventilation and atmospheric pollution by cities and by industries; and under water, both water supply and sewerage, which we purposely link together as complementary; and under food we treat two examples, the pasteurization of milk and the sanitary control of the collection and marketing of shellfish.

Among the matters of secondary importance considered are illumination, municipal cleansing and refuse disposal, and insect and rodent control. In each of these topics the stress is upon the fundamental chemical, physical, bacteriological, physiological or biological data upon which the engineering practice rests, and each topic therefore provides in its turn a basis for the construction of a considerable educational edifice of public health material.

Public Health Engineering Practice is an advanced course in which a special problem of some magnitude is developed by each student in a comprehensive manner.

The other foundation courses are vital statistics in which the material dealt with is directly related to public health, epidemiology with special stressing of the environmental factors, and sanitary engineering laboratory methods in which, as previously indicated, the student generally starts at the beginning and learns enough of chemical and bacteriological technic to complete a satisfactory examination of air, water, milk, or shellfish, and to understand and interpret the results of such examinations as well as those of the more strictly medical tests of blood, urine, throat cultures, etc.

These classroom courses are all of seminar nature, made possible by small groups of students, and are accompanied by extensive collateral reading and frequent reports by the student. Finally there is required during the summer a so-called field study in which the candidate is assigned to some definite organization, such as a state department of health, and is allowed to select a specific topic for survey or investigation under the actual conditions of practical administrative work. He is also required to take, either in connection with his field work or during the year, one optional study closely related to his selected field study and these together

provide the basis for his graduating thesis which completes the requirements for the degree.

The course outlined here parallels another course designed primarily for graduates in medicine or for students having had at least a full pre-medical college course and who likewise take the first general course in public health engineering. The objective here, however, is to provide a background for the proper interpretation of their future work in epidemiology and public health administration. The seminar method of teaching permits of considerable latitude in the assignment of problems and topics

for discussion and each of the two groups of students admirably supplements the other's viewpoint, to their mutual advantage.

In this way we recognize what we believe to be an essential distinction in public health activities, namely, the medical and the engineering aspects. In either case we have found it distinctly advantageous that the doctor of medicine or the civil engineer, as the case may be, has come to the decision to enter the profession of public health as a specialty and comes to us well prepared and with a definite objective as to his future career.

The Use of Activated Carbon in Removing Objectionable Taste and Odors—The author suggests the use of the terms "carbon adsorption beds" and "carbon units" rather than "carbon filters." Experiments have been conducted in units of two sizes, one a bed 3.56' in diameter and the other glass tubes about 1 $\frac{5}{8}$ " in diameter. Such glass tubes have been found to give results comparable with those of the larger units.

The results of 17 months' operation of the larger unit with Hydrodarco are described. The flow was upward at the rate of 2 gal. per sq. ft. per minute and the bed was washed twice during the period in the manner used for rapid sand filters. In the glass tubes comparative tests were carried out using 5 types of carbon (Hydrodarco, Minchar, Woodchar, Bonechar and Nuchar), and the actions of a 48" bed of fresh carbon and of carbon taken from the larger unit after 13 months' use and revived by heating and by treatment with sodium hydroxide were tested.

The results are given in tables. It appears from these results:

1. That fairly deep beds are to be preferred, a bed 48" in depth with water applied at a

rate of 4 gal. per sq. ft. per minute reducing residual chlorine to a lower figure than a 24" bed at 2 gal. per sq. ft. per minute.

2. That either upward or downward flow can be used. The maximum rate with upward flow is about 4 gal. per sq. ft. per minute with 4-12 mesh Hydrodarco. Higher rates can be used with downward flow but friction losses are greater and more frequent washings are necessary.

3. That the most suitable form of revivification depends on what the material has adsorbed. Where loss of activity was due to gelatinous compounds clogging the pores of the carbon, revivification for dechlorination was successfully achieved by drying at 105° C. or treating with a hot solution of sodium hydroxide.

4. That materials differing widely in carbon content are suitable for dechlorination.

5. That superchlorination followed by dechlorination by active carbon removes practically all taste producing compounds likely to be found in water.

6. That 1 lb. of Hydrodarco will reduce the residual chlorine in about 30,000 gal. of water from 1.0 to less than 0.1 p.p.m. without revivification, using a carbon bed 24" deep at a rate of 2 gal. per sq. ft. per minute. By revivifying the material it is believed that 200,000 to 500,000 gal. of water may be dechlorinated per lb. of Hydrodarco.

—J. R. Baylis, *J. Am. Water Works Assn.*, 22: 1438, 1930. From *Summary of Current Literature, Water Pollution Research*, IV, 6 (June), 1931.

The Sewage Treatment Works of Zurich, Switzerland—An account is given of the sewage works of Zurich, Switzerland. The original plant, which was constructed to serve about one-third of the population so that experience could be gained for the design of the complete works, consists of rainwater overflow weir, grit chamber, 2" bar screen, sedimentation chambers, pumps for sludge, separate sludge digestion chambers, sludge drying beds and lagoons.

The effluent from the sedimentation chambers is discharged into the river Limmat and the ripened sludge is lagooned and sold as fertilizer. The main changes from the old plant in the construction of the new plant are enumerated. Cost data and diagrams of the sedimentation and digestion tanks are included.—M. Suter, *Sewage Works J.*, 2: 419, 1930. From *Summary of Current Literature*, Water Pollution Research, IV, 6 (June), 1931.

Use of Sewage Gas as City Gas—The chemical composition, the volume and dependability of supply, and the cost of sewage gas are considered with regard to its use as a city gas. Although sewage gas has a sufficiently high heating value to be useful, its slow rate of flame propagation is a disadvantage and its high specific gravity would necessitate a greater expenditure of power for pumping than in the case of the ordinary types of city gas; the flame characteristics would be greatly improved if the sewage gas were mixed with some other type of gas to increase the hydrogen content.

Sewage gas would afford a reasonably dependable source of supply but its maximum production could rarely exceed 1 per cent of that required for city gas and it would be produced in greatest quantities in the summer when it was least required. Its value to a gas company is equal to the enriching value and

today enrichment can be obtained considerably more cheaply from bunker fuel oil.

The effect of temperature on digestion and the use of sewage gas for tank heating are discussed. A great saving in plant may be obtained by maintaining the temperature of digestion tanks close to the optimum temperature for digestion, i.e., in the vicinity of 77° F. It has been found that if the sewage gas is collected and used for heating the tanks, the temperature may be maintained above 70° F. throughout the year and thus the rapidity of digestion and capacity of the plant may be greatly increased.

It is concluded that the collection of sewage gas is justified if it is burned to prevent nuisance or utilized for heating the contents of digestion tanks, but it is not justified in the United States for use as a substitute for city gas.—W. H. Fulweiler, *Sewage Works J.*, 2: 424, 1930. From *Summary of Current Literature*, Water Pollution Research, IV, 6 (June), 1931.

Refuse Disposal and Steam Power—The Huddersfield destructor was built solely for the utilization of the refuse to generate steam. The following conditions had to be met in the design of such a plant: (1) A constant output of steam per hour; (2) maximum steam production per lb. of refuse burnt; (3) a great degree of mechanization of refuse handling.

The plant as constructed is probably the most efficient steam raising refuse incineration plant in existence at present. The plant will produce a steady supply of steam hour after hour and day after day. A harder clinker is produced than usual and the manual labor used in handling the refuse is reduced to a minimum. All refuse, even dust—excepting metals—is incinerated.

The incinerator will handle 28,000 tons of refuse per year; 500 tons of

metal and 5,000 tons of clinker, besides the steam, will be recovered for sale. Innocuous dust will be the only material dumped and will amount to about 15 per cent of the total refuse.

The plant will handle 180 tons of refuse in 18 hours (calorific value—5,000 B.T.U. per lb. as charged), by means of 8 Woodall-Duckham furnace type cells. Each boiler is served by the gases from two cells. The refuse is discharged into a storage hopper below ground level from the collecting wagons. The refuse is raised from the storage hopper by means of a grab and conveyed to a rotary distributor.

From the distributor the refuse goes through a magnetic separator where the metals are removed. The metals are sent to a baling press and the other refuse is sent to an auxiliary storage pit from where it is delivered by means of a grab to the feeding hoppers. The refuse is fed to the furnaces by means of hydraulically operated rams and is burnt by means of a pre-heated high pressure air supply delivered through tuyeres placed at the lower part of the furnace.

The non-combustible portion of the refuse is converted into a hard clinker. The gases of combustion are drawn through water-tube boilers and ejected into the chimney by means of dust extracting waste-gas fans. Each boiler is fitted with dust collecting chambers and arranged so that dust can be removed during operation. The steam is supplied to the electricity department.

Each furnace cell has a hydraulically operated clinker knife and door through which the clinker is discharged into a skip. The clinker is quenched in a suitable quenching tower and then crushed and graded after passing

through a magnetic separator. The cost of the installation was £65,000.—Anon., *Surveyor*, 78, 2021: 383-386 (Oct. 17), 1930. From *Pub. Health Eng. Abstr.*, Jan. 31, 1931. Abstr. C. T. Carnahan.

Special Equipment and Careful Supervision in Los Angeles County Remove Objections to Garbage Disposal by Hog Feeding—A survey of 62 municipalities in this country indicates that the average cost of collecting garbage is \$2.94 per ton. Other data show that where garbage is disposed of by hog feeding an average of \$1.05 per ton is paid to the community by those collecting the garbage for disposal by hog feeding. Such disposal, therefore, reduces the net cost of collection to \$1.89 per ton.

There are extensive hog farms in use in Los Angeles County to serve 44 municipalities and very successful results have been secured because of expert supervision, inoculation of hogs, the use of concrete feeding platforms, suitable shelters and adequate equipment for the disposal of unconsumed garbage and manure. These results have been secured largely through the control of hog ranches by the Los Angeles County Live Stock Department.

Thirty-nine licensed ranches were operated in 1929 and only three complaints were received relative to nuisances. Two of these complaints were due to one small plant where the owner neglected to dispose of the manure properly. The third complaint related to an odor temporarily present when a compost pile was removed.—L. F. Conti, *Am. City*, 43, 6: 86-89 (Dec.), 1930. From *Pub. Health Eng. Abstr.*, Jan. 31, 1931. Abstr. C. R. Cox.